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METHOD AND DEVICE FOR LOCKING

The present invention concerns a method and a device for locking a circuit breaker and a grounding switch in order to be used as a disconnecting breaker.

The prior art

Switching of power lines, cables, power transformers, etc. is done by circuit breakers. Safety regulations have earlier required a disconnector with a visually open conductor spacing during work on, for example, a high voltage switch gear. According to the traditional solution, a breaker and a disconnector have together ensured that the section of the equipment where the work is to be carried out is disconnected. This type of solution requires at least one, and often two, disconnectors with demanding maintenance in order to ensure their correct function. Each disconnecting breaker must be correctly installed with a foundation that requires space and expensive installation time. The present invention is intended to solve the problems described above. The intention is to provide a compact solution, reliable from the point of view of safety, that is simple to manufacture and cost-effective for the customer. The construction permits manufacture of the parts according to known technology.

Summary of the invention

The present invention concerns a method and a device for locking a circuit breaker and a grounding switch to be used as a disconnecting

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breaker. The earlier requirement for a visually open disconnector has been replaced according to new regulations by the requirement for a reliable indication that a section of the equipment is disconnected. The disconnecting breaker replaces a circuit breaker, one or two series connected disconnectors, and means for grounding. The disconnecting breaker can be either of single-pole type or multiple-pole type depending on its operating voltage.

During locking of a single-or multiple-poled disconnecting breaker that includes a linkage system, known as a "rod system", for closing and opening operation of the contacts of the breaker, the actuator of the breaker is first locked electrically and/or mechanically, after which the linkage system may also be solidly locked by a mechanical device. When the breaker is in the open position, the distance between the contacts of the breaker constitutes the conductor spacing of the disconnecting function, and is large enough to provide the electrical insulation required for the disconnecting function. The electrical and mechanical locking of the actuator is indicated both electrically and by suitable indicators (lamp, arrow, etc.). Following the safe locking of the breaker in the open position, the grounding switch can be operated to safely ground one of the breaker terminals.

The locking of the actuator of the breaker is achieved with the aid of an electromagnetic blocking unit that can be operated with a hand-operated key-and lock device. The blocking unit can in one preferred embodiment be

operated by remote control, e.g. by interrupting the control power to the actuator. In one preferred embodiment, operation of a hand-operated key- and lock device controls an electromagnet that locks a blocking package of the actuator of the breaker by both breaking the operating current to the actuator and by mechanically blocking the actuator. The key device is freed from the lock device following the locking of the actuator of the breaker and is used in a second lock device for mechanical locking of the rod system with the aid of a blocking unit. The rod system is locked in the open breaker position with a second key device and a third lock device. The blocking of the rod system is indicated by at least one indicator.

According to one embodiment of the device, the second key device is used with a fourth lock device in order to free a blocking unit, which makes it possible to move a grounding switch, also known as an earth knife or other earth device. Once the earth knife has been connected to one of the breaker contacts, the earth knife is blocked in its connected position and locked with the second key device and the fourth lock device.

The electrical and mechanical locking of the actuator of the breaker can in one preferred embodiment be achieved with a remote-controlled locking device. The remote-controlled locking of the actuator of the breaker is indicated by electrical and mechanical indicators on the breaker and by indicators on the remote-control unit. In an exemplary embodiment the remote-controlled locking device includes the operation of a blocking device

for the earth knife, during which operation, movement of the earth knife causes blocking of the rod system. The system according to the invention is very reliable from the point of view of safety due to the locking in one preferred embodiment being performed by the exchange of keys, and due to electrical and mechanical indicators showing in multiple ways that the breaker is safely locked to prevent any operation.

Brief description of the figures

Fig. 1 shows a sketch of the principle of a disconnecting breaker for a three-phase system.

Fig. 2 shows a sketch of the principle of a disconnecting breaker for a single-phase system.

Figs. 3A-3C show an actuator (a), including an electromagnet (b) and an external surface (c) for operation of a breaker.

Figs. 4A-4B show locking of the rod system (a) with a blocking plate and lock (b).

Fig. 5 shows an actuator for an earth knife together with locking of the earth knife with a blocking unit equipped with a lock.

Figs. 6A-6C show the disconnecting breaker with earth knives (a), blocking device (b) and rotating disk (c) of the locking arrangement of the rod system during remote control.

Detailed description of preferred embodiments

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Fig. 1 shows a sketch of the principle of a disconnecting breaker for three poles. An actuator 10 controls a link system, known as a rod system, 20 which connects the poles together and controls the positions of the contacts 30 of the breaker. The positions of the contacts 30 of the breaker are indicated on each pole, for example with a mechanical arrow 70. An earth knife 40 is controlled by its own actuator 50, which is in direct electrical connection with the actuator 10 through a cable 60 connected between the actuators. When the disconnecting breaker is locked, the actuator 10 is first locked both electrically and mechanically with the aid of an electromagnet 12. After this, the rod system 20 of the breaker 30 is locked mechanically. The indication is achieved in one preferred embodiment electrically with a lamp and mechanically with, for example, an arrow. The key-and lock device in one preferred embodiment is a Castel lock with the associated keys. When both the actuator 10 and the rod system 20 are locked, manual operation and locking of the earth knife 40 according to known technology are possible.

Fig. 2 shows a sketch of the principle of a disconnecting switch for a single pole. An actuator 10 controls a link system, also known as a rod system, 20 which controls the position of the breaker contacts, e.g. the contacts 30. The positions of the breaker contacts are indicated, for example, with a mechanical arrow 70. An earth knife 40 is controlled by its own actuator 50, which is in direct electrical connection with the actuator 10

through a cable 60 connected between the actuators. When the single-pole disconnecting switch is locked, the breaker is locked according to the same principle as the three-pole disconnecting switch.

One embodiment of the present invention provides a device for locking a circuit breaker in an open or closed position. In this embodiment, a set of breaker contacts operated by a linking system is in mechanical communication with an actuator. Operation of the actuator, in turn, moves the set of breaker contacts into either an open or closed position by moving the linking system. The position of each of the set of breaker contacts may be indicated by an indicator, for example, by a mechanical arrow. In addition to operating the linking system to open or close the set of breaker contacts, the actuator may further contain devices for locking the linking system in the open or closed position by both mechanical and electrical means.

Operation of the breaker is controlled by an actuator driving the linking system. An electromagnet is used to position at least one locking shackle so as to mechanically prevent operation of a blocking package, which mechanically prevents operation of the actuator thereby maintaining the set of breaker contacts in the open or closed position. Electrical locking is achieved by disconnecting the operating current to the electromagnet operating the locking shackle after positioning this locking shackle. Therefore, once electrical locking has occurred, the positioned locking shackle may not be retracted by the electromagnet until such current is

restored. Electrical locking may be indicated by mechanical and/or electrical indicators present on the actuator, for example, by illumination of a green lamp and/or a mechanical arrow pointing to a green field.

In one embodiment, the far end of the rod attached to the actuator extends outward from the outer breaker pole housing when the breaker contacts are in the open position and thus allows for it to be mechanically blocked by a physical connection, for example, to a blocking plate or other similar device to prevent the rod from moving once the breaker is in the open position. The visible extension of the rod upon placing the breaker contacts in the open position further serves as an indicator that the breaker is in an open position and allows for closing of the earth knife. The position of the blocking plate can be designed to serve as an indicator that blocking by the blocking plate has been achieved.

Figs. 3A-3C show the actuator 10 for control of the rod system 20 and thus the position of the contacts 30. The actuator 10 includes a blocking package 11 that solidly prevents mechanical movement of the actuator 10 and thus also any operation of the breaker contacts. The blocking package 11 prevents operation of the breaker 30 together with an electromagnet 12 equipped with a mechanical locking shackle 13 or equivalent device. The mechanical locking shackle 13 or equivalent device mechanically prevents any unintended movement of the blocking package. When a first key 18 is turned in the lock 14, the electromagnet 12 releases, and operating current

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to the blocking package 11 is interrupted. The blocking package 11 is locked by breaking its operating current and by turning off the operating current to the electromagnet 12 equipped with the mechanical locking shackle 13. Under the condition that the breaker is in the OFF position, the shackle 13 is released downwards and mechanically blocks movement of the blocking package from the OFF position to the ON position. Indication that locking of the actuator is achieved may, for example, be realized by the lighting of a green lamp 19 on the external surface of the actuator and by a mechanical arrow 16 pointing towards a green field of a mechanical arrow 16 inside the actuator. An auxiliary contact 17 provides electrical interruption or closing of a signal, which indicates the position of the breaker. When the breaker is OFF and the actuator is locked, a signal is sent via the auxiliary contact 17 and the cable 60 to the actuator 50 of the earth knife. This is one of the conditions that must be satisfied if movement of the earth knife is to be possible. If the breaker is in the ON position when the actuator is locked, the breaker can in one preferred embodiment be automatically switched over to the OFF position. In one preferred embodiment the actuator of the breaker can be locked with the breaker in the ON position. The indicator 70 then indicates that the breaker is in the ON position. Movement of the earth knife is not possible in this condition since this requires a signal via the auxiliary contact 17 and the cable 60 to the actuator of the earth knife.

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Figs. 4A-4B show part of a link system, known as a rod system, 20 for operation of the contacts 30 of the breaker. The rod system 20 is equipped with a moving part 21 that is in an inner position when the breaker is ON and an outer, visible position when the breaker is OFF. Figure 4B shows an exemplary blocking plate 23. As can be seen with respect to Figure 4B, a hole in the blocking plate 23 includes a first region 202 large enough to permit the moving part 21 to move or rotate freely, and a second region 204 that is smaller than the first region 202. As can be seen from Figure 4B, the second region 204 is large enough to receive the moving part 21 when the moving part 21 is rotated 90 degrees to align with the second region 204, and will prevent the moving part 21 from rotating when the moving part 21 is in the second region 204, e.g. after the blocking plate 23 has been pushed in a sideways direction. By turning the first key 18 in a second lock 22, manual movement of a blocking plate 23, or other blockage device, is made possible. The blocking plate 23 is pushed in a sideways direction and locked in place with a second key 24 in a third lock 25 such that the moving part 21 and thus the rod system 20 are locked into positions corresponding to open breaker. The locking of the rod system can be indicated with, for example, an arrow.

Fig. 5 shows the earth knife 40 with its actuator 50. The position of the earth knife is controlled by a link system 51.

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Figs. 6A-6C show the design of the rod system when remote-controlled locking is used. Movement of the earth knife involves movement of the blocking plate 23 via a rotatable disk 80.